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An Evaluation of Methods for Determining The Linters Content of Cottonseed

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AN EVALUATION OF METHODS
FOR DETERMINING THE LINTERS CONTENT OF COTTONSEED

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INTRODUCTION

Results of tests made with the forced-draft, infra-red and vacuum methods of determining the linters content of cottonseed were reported in June 1955. 1/ Further work was indicated since the infra-red method and the infra-red oven were considerably revised subsequent to the tests reported above. Accordingly, arrangements were made to field test the methods, including revisions, in two areas of the Cotton Belt; namely Memphis, Tennessee, and Fort Worth, Texas.

TEST PROCEDURE

A series of tests was made at The Barrow-Agee Laboratories, Memphis, Tennessee with the infra-red and vacuum methods using well-known varieties of cottonseed with low, medium and high linters content. The same series was repeated at The Fort Worth Laboratories, Fort Worth, Texas with the forced-draft and vacuum methods.

Moisture was artificially added for medium and high moisture seed tests to Deltapine, Rowden, and Delfos varieties of cottonseed. Samples were mixed after adequate time was allowed for moisture equilibrium and were again mixed immediately before testing.

Twenty observations were made on each sample of cottonseed for each moisture range by the infra-red method and vacuum method at Memphis and by the forced-draft method and vacuum method at Fort Worth. A total of nine series of tests was made at each location.

MEMPHIS TESTS

A series of 20 replications was made at Memphis by the infra-red and vacuum methods of linters determination. The standard deviation by the vacuum method remained at the level reported in AMS-51. On the other hand results by the infra-red method were

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1/ "An Evaluation of Methods for Determining the Linters Content of Cottonseed", by Marion E. Whitten and Charles E. Holaday, Cotton Technologists, U. S. Department of Agriculture, AMS-51, June 1955, Washington, D. C.

much better than were found previously. The standard deviation by the infra-red method averaged ±0.10 as compared with ±0.36 found in the earlier tests (table 1). This excellent repeatability was largely due to improvements in the method and to redesign of the infra-red oven.

Table 1.-- Comparison of results of linters determinations obtained by the infra-red method and vacuum method at Memphis, Tenn., July, 1955.

Cottonseed		Infra-red Method		Vacuum Method	
	Moisture Content	Linters Content	Standard Deviation	Linters Content	Standard Deviation
	Percent	Percent	Percent	Percent	Percent
Delfos.....	6.3	9.0	±0.12	9.0	±0.12
Delfos.....	12.8	8.4	±0.05	8.5	±0.10
Delfos.....	19.1	8.3	±0.15	8.6	±0.25
Deltapine..	6.6	10.3	±0.09	10.4	±0.17
Deltapine..	14.2	9.1	±0.19	1/	1/
Deltapine..	20.2	8.5	±0.07	8.8	±0.19
Rowden.....	6.6	15.1	±0.10	15.0	±0.20
Rowden.....	13.6	13.9	±0.10	14.1	±0.21
Rowden.....	20.5	13.2	±0.12	13.5	±0.21

1/ Fuse blown ruining determination - no additional seed available.

FORT WORTH TESTS

A comparison of the forced-draft and vacuum methods was made at Fort Worth on the same types of cottonseed as were used in the Memphis tests. (The infra-red equipment was not available at Fort Worth.)

In the Fort Worth tests, an average moisture content was used with each lot of seed when calculating the linters content by the forced-draft method whereas in the Washington tests reported in AMS-51, individual moisture determinations were used on each of the observations. Variation in moisture content from sample to sample would therefore be reflected in the Washington results in addition to other variables. On low moisture cottonseed, the standard deviation found in Fort Worth and Washington checked rather closely (table 2). On medium moisture content seed, the standard deviation of the Washington results were slightly higher. On high moisture cottonseed, however, the forced-draft method results at Fort Worth, though higher, were only one-fourth that found in Washington. This very clearly indicates the magnitude of error attributable to the inclusion of moisture in the forced-draft method. (When a uniform moisture content was used with the findings in Washington on the forced-draft method, results were comparable with those found in Fort Worth.)

Table 2.-- Comparison of results of linters determinations obtained by the forced-draft method 1/ and vacuum methods at Fort Worth, Tex., July 1955.

Cottonseed		Forced-draft Method		Vacuum Method	
Mark	Moisture Content	Linters Content	Standard Deviation	Linters Content	Standard Deviation
	Percent	Percent	Percent	Percent	Percent
Delfos.....	6.8	9.0	±0.10	9.0	±0.14
Delfos.....	14.3	8.2	±0.33	8.3	±0.14
Delfos.....	19.8	8.0	±0.28	8.1	±0.11
Deltapine..	6.7	10.3	±0.25	10.2	±0.13
Deltapine..	14.5	8.8	±0.17	8.6	±0.12
Deltapine..	20.8	8.5	±0.27	8.6	±0.11
Rowden.....	6.5	14.8	±0.28	14.7	±0.20
Rowden.....	13.9	14.3	±0.44	14.1	±0.15
Rowden.....	19.4	13.5	±0.24	13.4	±0.16

1/ An average moisture content was used in computing the linters content whereas individual moisture determinations were used in the Washington tests reported in AMS-51.

INFRA-RED LINTERS METHOD INCLUDED AS AN OFFICIAL METHOD

The excellent results obtained by the infra-red method of determining the linters content indicated the desirability of its inclusion in the official methods of chemical analysis for use by chemists licensed by the U. S. Department of Agriculture for analyzing and grading cottonseed. Accordingly, the infra-red method was included in the "Methods" which were reissued in August 1955.

COMPARATIVE ACCURACY OF INFRA-RED AND FORCED-DRAFT METHODS

In the 1955-56 check cottonseed series of the American Oil Chemists Society, 14 chemists licensed by the U. S. Department of Agriculture determined the linters content by the infra-red method and 18 licensed chemists used the forced-draft method. Each sample provided chemists for the linters determination was adequate for five observations. Excluding one wild result by each method, probably attributable to sampling error, the standard error of difference of the reported results on the entire series was ±0.22 by the infra-red method and ±0.30 by the forced-draft method. When all results were considered, standard errors of ±0.26 and ±0.40 were found by the infra-red and forced-draft methods, respectively. (Standard errors were computed in relation to the accepted average of all collaborators in the check series.) This would indicate significantly greater accuracy by the infra-red method. If high moisture seed had been included in a series, results by the forced-draft method would probably have shown a much higher standard error (AMS-51, p. 18).

MOISTURE CONTENT AND REGAIN OF FUMED LINTERS

The most serious source of error in both the infra-red and vacuum methods is the moisture content of the fumed linters. If the moisture content of the fumed linters materially changes between the time of brushing from the seed and the weighing of the linters sample for a moisture determination, an error commensurate with the moisture regain will result.

A series of delinting tests were made on cottonseed with low, medium and high moisture contents cottonseed (6 percent, 14 percent and 20 percent, respectively) with the vacuum oven. Individual samples of fumed cottonseed were brushed with the sponge rubber disc apparatus (AMS-51, p.3). The official oven moisture contents of the fumed linters were 1.0 percent, 1.7 percent, and 2.4 percent, respectively. Karl Fischer moisture determinations which were made on duplicate samples gave similar results.

Memphis Tests

During the Memphis tests, samples of fumed linters for moisture determination were removed from the vacuum reservoir of the Barrow-Agee brushing device after each series of 20 samples were brushed. The temperature and humidity were unusually high at the time of these tests. The moisture content of vacuum method fumed linters were found to be somewhat higher than infra-red fumed linters (table 4).

A plausible reason for the higher moisture in vacuum fumed linters is that more difficulty was experienced in removing the vacuum method linters from the seed thereby allowing more time for the air to pass over (not through) the linters collecting in the brushing machine reservoir.

Table 3.-- Moisture content of cottonseed and of fumed linters removed from reservoir of brush machine after each twenty sample series was brushed.

Type of Cottonseed	Cottonseed Moisture Content	Moisture Content: Fumed Linters removed from Brush Reservoir after 20 brushings: Infra-red Method	Moisture Content: Fumed Linters removed from Brush Reservoir after 20 brushings: Vacuum Method
	Percent	Percent	Percent
Deltapine	6.6	4.6	4.3
Deltapine	14.2	4.3	4.5
Deltapine	20.6	4.7	5.3 1/
Delfos	6.3	4.2	5.2
Delfos	12.8	4.0	4.3
Delfos	19.1	4.2	5.3 1/
Rowden	6.6	4.0	3.8
Rowden	13.6	3.9	4.4
Rowden	20.5	4.1	4.9

1/ Composite sample of two lots. By mistake, the sample was not removed at the end of one 20 sample series.

Moisture Regain of Fumed Linters

The variation in moisture content of fumed linters indicated the need for more information on the degree of regain or uptake of moisture. Accordingly, samples of fumed linters were subjected to the atmosphere at controlled temperature and humidity conditions. With a relative humidity of 20 percent,the fumed linters regained very little moisture (figure 1). On the other hand, a considerable regain was experienced with relative humidities of 60 percent and 75 percent.

Samples of fumed linters were dried and were placed in controlled atmospheric conditions. The moisture regain followed the same pattern as did those which were not completely dried.

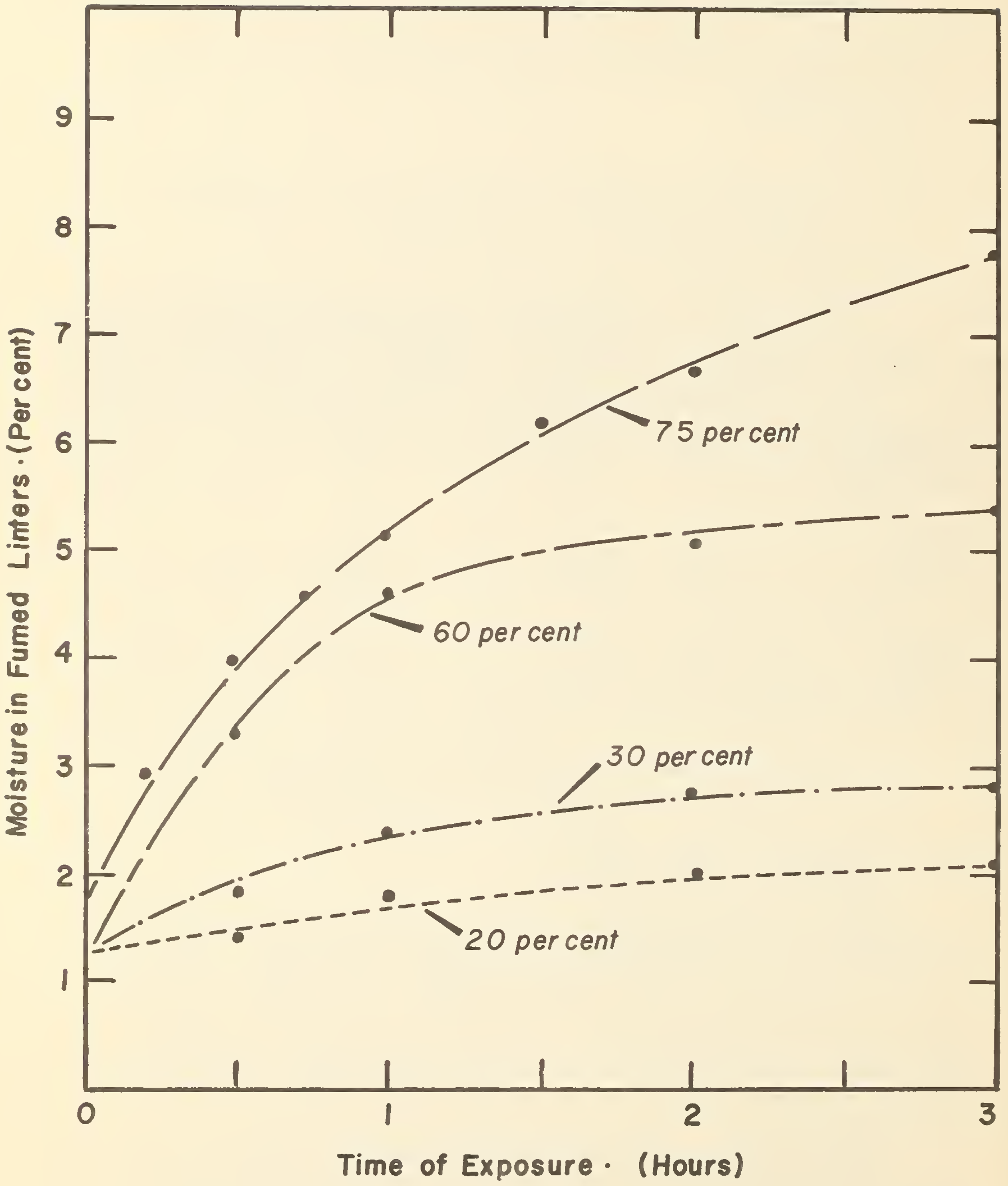

Figure 1 — Moisture regain in Fumed Linters at 76° Fahrenheit and specified relative humidities.

On the basis of these tests, it appears that great care must be exercised in selecting samples for moisture in fumed linters, especially when the relative humidity is high.

Method of Holding Fumed Samples Dry

To expedite the handling of large numbers of forced-draft method fumed cottonseed samples, The Fort Worth Laboratories have used a novel method of holding samples warm and dry. A warming oven, made of wood and using electric light bulbs as a heat source, has been successfully used in holding seed dry until brushing facilities were available. Brushing was more rapid as well as more efficient than found previously when samples were allowed to cool and regain moisture.

Effect of Moisture Regain in Linters upon Results

In order to ascertain the effect of moisture regain in fumed linters upon the resulting linters content, the dry basis results obtained by the vacuum method at Fort Worth are compared with results assuming 1.0 percent, 2.0 percent and 2.5 percent moisture contents in fumed linters from cottonseed of low, medium and high moisture content cottonseed (table 5). The vacuum method results, assuming the linters were dry, varied more on high moisture content cottonseed when compared with the forced-draft method results. This indicates (1) there is a need for inclusion of moisture content of fumed linters in the vacuum method and (2) that the moisture contents suggested above and used in computations in table 5 may be used with the vacuum method if brushing is done while the seed are warm. It also indicates the magnitude of error which may result from the assumption that no moisture remains in the fumed linters.

Table 4.-- Linters content of cottonseed by the vacuum method and forced-draft method on cottonseed of low, medium and high moisture contents - Fort Worth tests.

Type Cottonseed	Moisture Content	Total Linters Content 8 Percent Moisture Basis		
		Forced Draft Method	Vacuum Method	
			Linters Content 1/	Linters Content, Dry Fumed Linters
	Percent	Percent	Percent	Percent
Delfos......	6.8	9.0	9.0	9.1
Delfos......	14.3	8.2	8.3	8.4
Delfos......	19.8	8.0	8.1	8.2
Deltapine...	6.7	10.3	10.2	10.4
Deltapine...	14.5	8.8	8.6	8.7
Deltapine...	20.8	8.5	8.6	8.7
Rowden......	6.5	14.8	14.7	14.8
Rowden......	13.9	14.3	14.1	14.4
Rowden......	19.4	13.5	13.4	13.7

1/ Moisture content of fumed linters from low moisture, medium moisture and high moisture seed assumed to be 1.0 percent, 2.0 percent and 2.5 percent, respectively.